

Nova Laser Facility



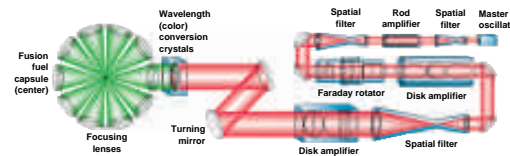
Since 1985, Lawrence Livermore National Laboratory's Nova laser facility* has been the world's primary research tool for Inertial Confinement Fusion (ICF).** With Nova, named for stars that suddenly become explosively bright, we are working to better understand the nuclear fusion process that is the source of energy for our sun and all other stars. Both nuclear fusion and nuclear fission occur in thermonuclear weapons. The illustration in the bottom right describes nuclear fusion and fission reactions.

The illustration in the bottom left describes the ICF process. In laser fusion, we use powerful lasers to re-create the fusion process in miniature. A spherical fuel capsule about the size of a grain of sand contains the deuterium-tritium fuel used for laser fusion. Laser beams can illuminate these fuel capsules directly or indirectly (middle left).

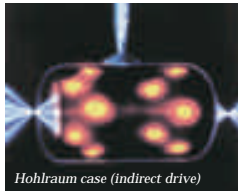
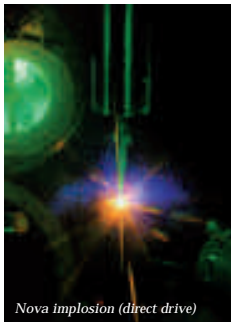
The cutaway view below shows the layout of the Nova laser bay and target chamber. Within the laser bay, a space frame supports the 10 laser amplifier chains (top right). A system of mirrors and lenses causes any number of the 10 laser beams to simultaneously illuminate the fusion fuel target, which is centered in a spherical target chamber (top left).

The Nova laser facility has five features that make it unique and flexible. First, it can deliver very high power to its targets (about 15 trillion watts of ultraviolet light for 3 billionths of a second). Second, the laser light pulse can be "shaped" in time and intensity, which increases fuel compression efficiency. Third, an array of crystals can "tune" the laser system to produce laser light pulses of different wavelengths. Most common wavelengths are either invisible infrared light or shorter-wavelength visible green or ultraviolet blue light. Fourth, Nova has two target chambers, which doubles its experimental capacity. Fifth, Nova's diagnostic capabilities are world-class. This combination of powerful features makes Nova an invaluable tool for gathering data about nuclear fusion.

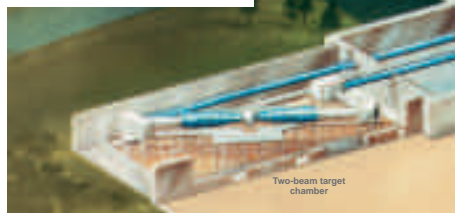
Nova Laser Beamline



Laser Bay



Target Chamber

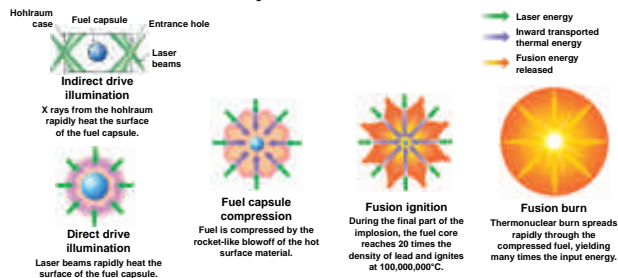


ICF Fusion Power Plant

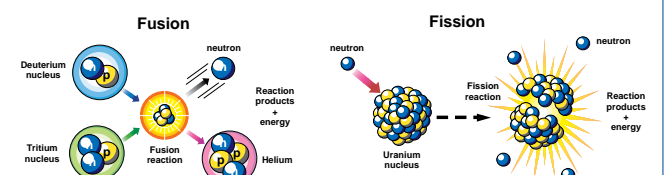


In ICF power plant concepts, the driver—the energy source that starts the fusion reaction—and the fusion chamber are separate, which brings flexibility to the design. Drivers other than lasers, such as particle beams made of energetic ions, are also possible. The next step in demonstrating fusion power is the DOE's National Ignition Facility (NIF), being constructed at LLNL as a key element of our country's Stockpile Stewardship and Management Program.** The NIF will demonstrate fusion ignition and energy gain, which is central to proving the feasibility of fusion as an energy source.

Four Steps of the ICF Process



Nuclear Reactions



Both fusion and fission reactions release the binding energy of atomic nuclei: the energy that holds the protons and neutrons of the nuclei together. Thermonuclear fusion is the process by which light elements are combined, or fused, at high temperatures and pressures. Fusion of ordinary hydrogen into helium produces the sun's energy; however, the most easily initiated fusion reaction occurs between deuterium and tritium, both of which are heavy isotopes of hydrogen (i.e., they have extra neutrons in their nuclei). The three methods of confining fusion fuel reactions are gravitational confinement, which occurs inside stars, and magnetic and inertial confinement, which can be achieved in a laboratory.